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Moriyasu et al.

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(54) **CARD EDGE CONNECTOR**

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(58) **Field of Classification Search**
CPC H01R 12/53; H01R 12/51; H01R 12/721; H01R 12/75; H01R 13/6456
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,934,961 A 6/1990 Piorunneck et al.
7,416,451 B2 * 8/2008 Tanaka G06K 7/0021 439/630

(Continued)

FOREIGN PATENT DOCUMENTS

JP 63-167684 11/1988
JP 2-244580 9/1990

(Continued)

OTHER PUBLICATIONS

International Search Report of Sep. 10, 2013.

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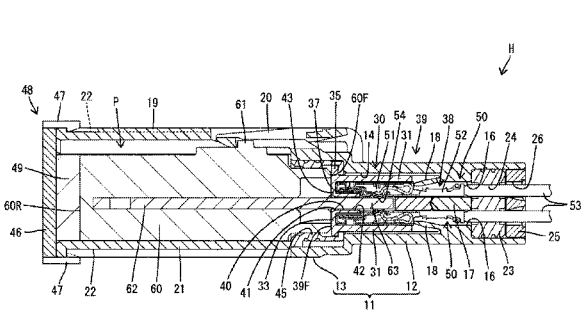
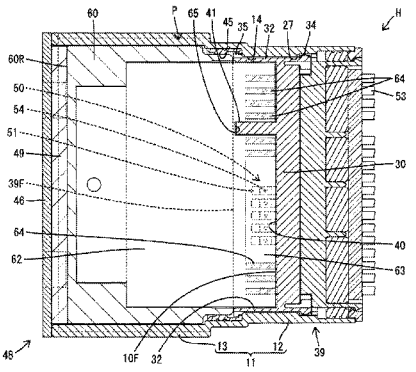
(57) **ABSTRACT**

A card edge connector includes supporting walls (**31**) provided along a plurality of juxtaposed terminal fittings (**50**) and configured to receive reaction forces from the side of a circuit board (**62**) due to a resilient pressing action of resilient contact pieces (**54**) and a front wall (**33**) connected to front end edges of the supporting walls (**31**). The front wall (**33**) is formed with a board insertion port (**41**) in the form of a slit-like opening substantially parallel to a juxtaposition direction of the terminal fittings (**50**) and communicating with a board accommodation space (**40**) and a coupling portion (**44**) configured to couple two long-side opening edges (**43**) substantially parallel to the supporting walls (**31**). The circuit board (**62**) is formed with a cut (**65**) configured to avoid interference with the coupling portion (**44**) in a state inserted in the board accommodation space (**40**).

12 Claims, 7 Drawing Sheets





(51) **Int. Cl.**

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H01R 13/42	(2006.01)
H01R 13/64	(2006.01)

(56) **References Cited**

U.S. PATENT DOCUMENTS

7,648,399	B1 *	1/2010	Lai	H01R 27/00 439/630
2004/0214474	A1 *	10/2004	Tsai	H01R 43/0256 439/630
2013/0005190	A1 *	1/2013	Blanchfield	H01R 12/721 439/630
2013/0034994	A1 *	2/2013	Kuang	H01R 12/721 439/607.22
2013/0316585	A1 *	11/2013	McGrath	H01R 13/6471 439/630
2013/0316586	A1 *	11/2013	Nagamine	H01R 12/721 439/630
2014/0148060	A1 *	5/2014	Li	H01R 13/405 439/630

FOREIGN PATENT DOCUMENTS

JP	8-185920	7/1996
JP	2008-91047	4/2008

* cited by examiner

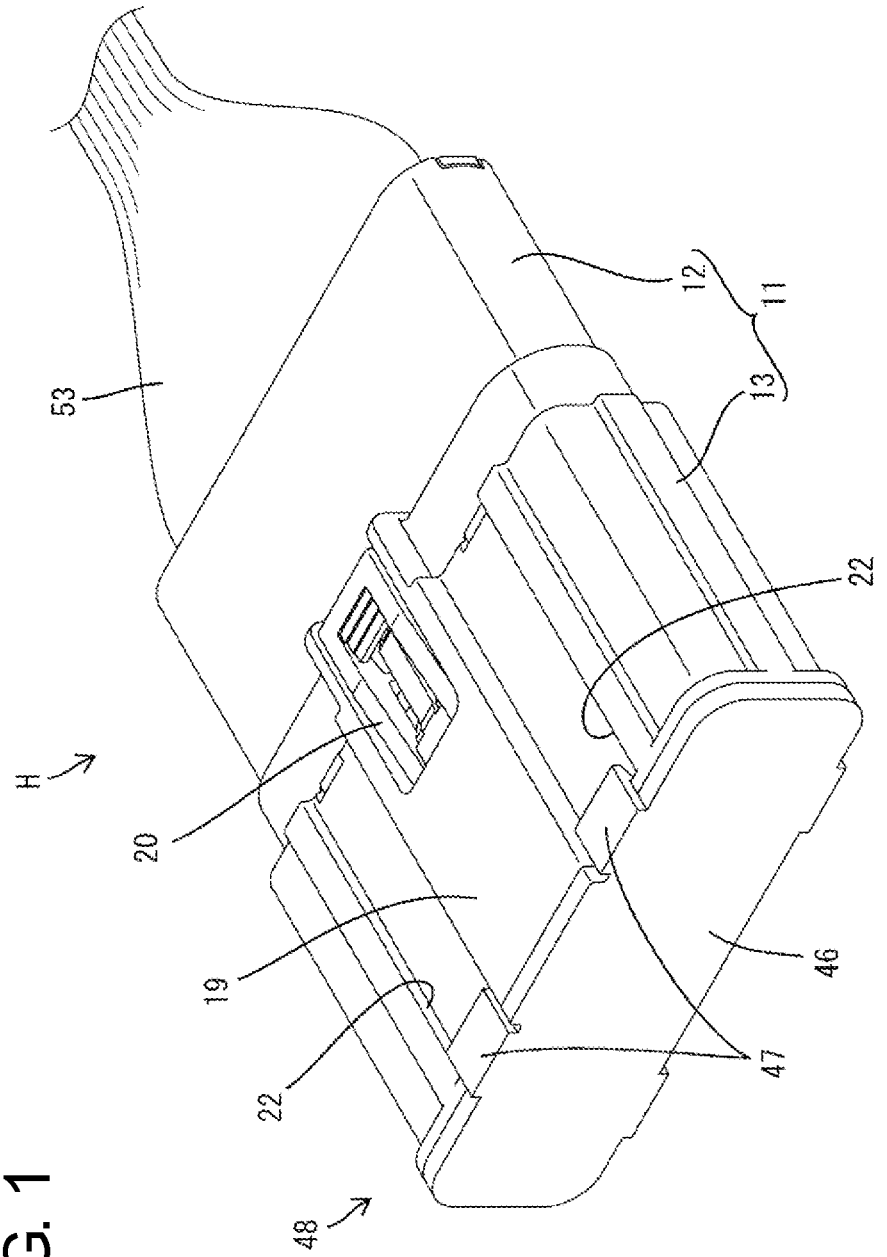
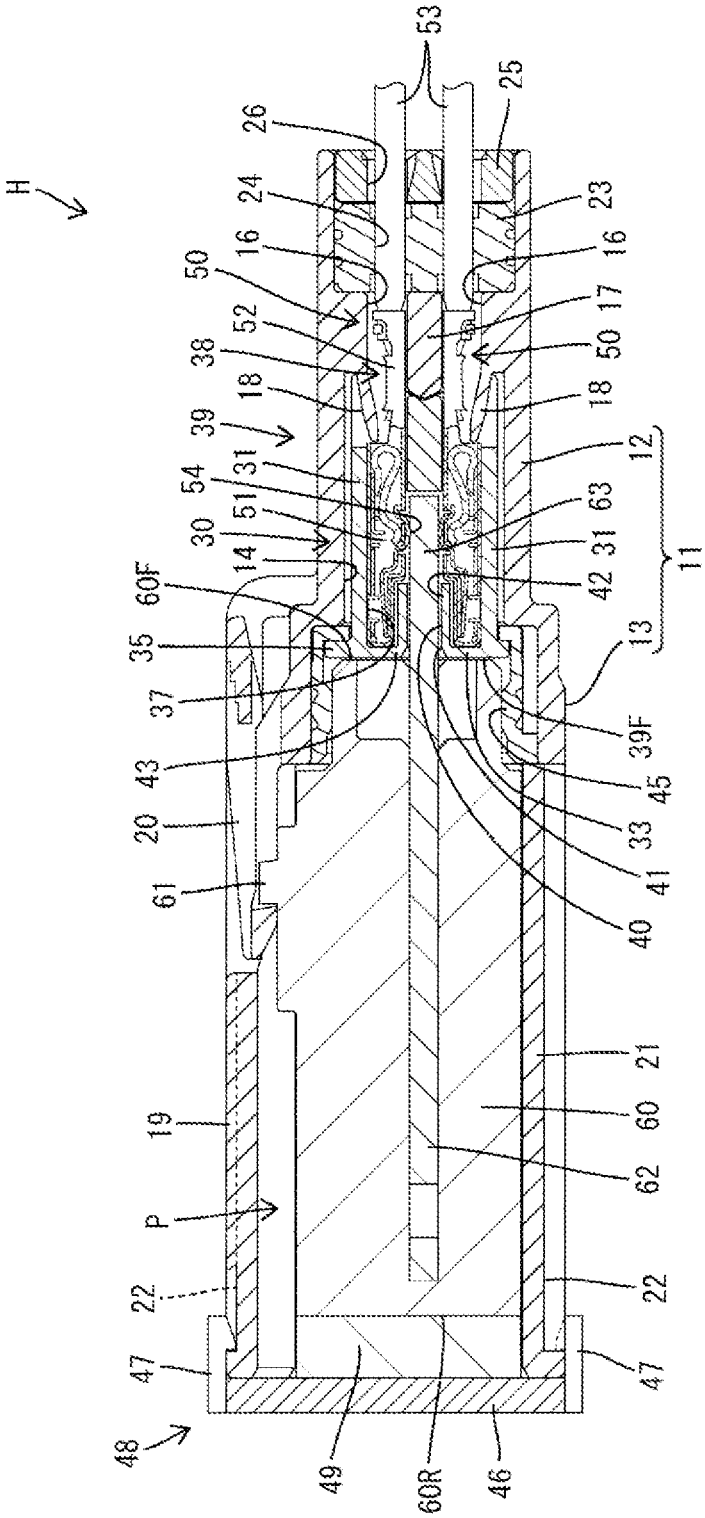


FIG. 1

FIG. 2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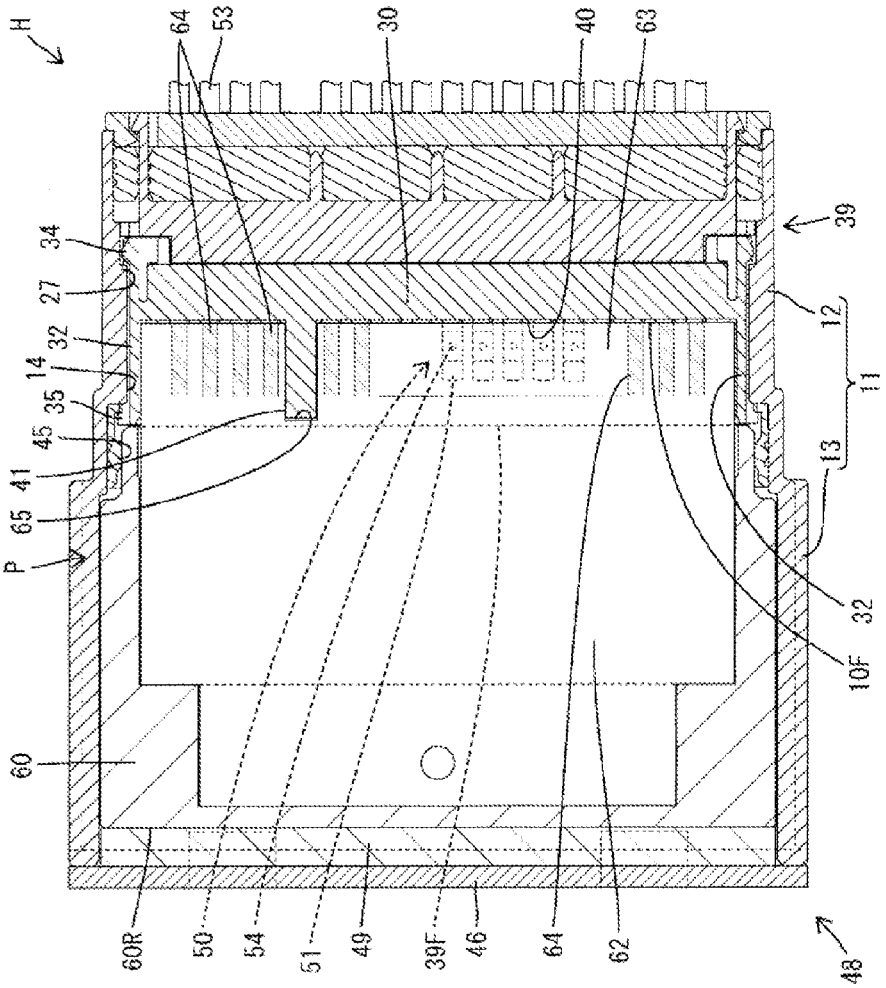
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FIG. 3

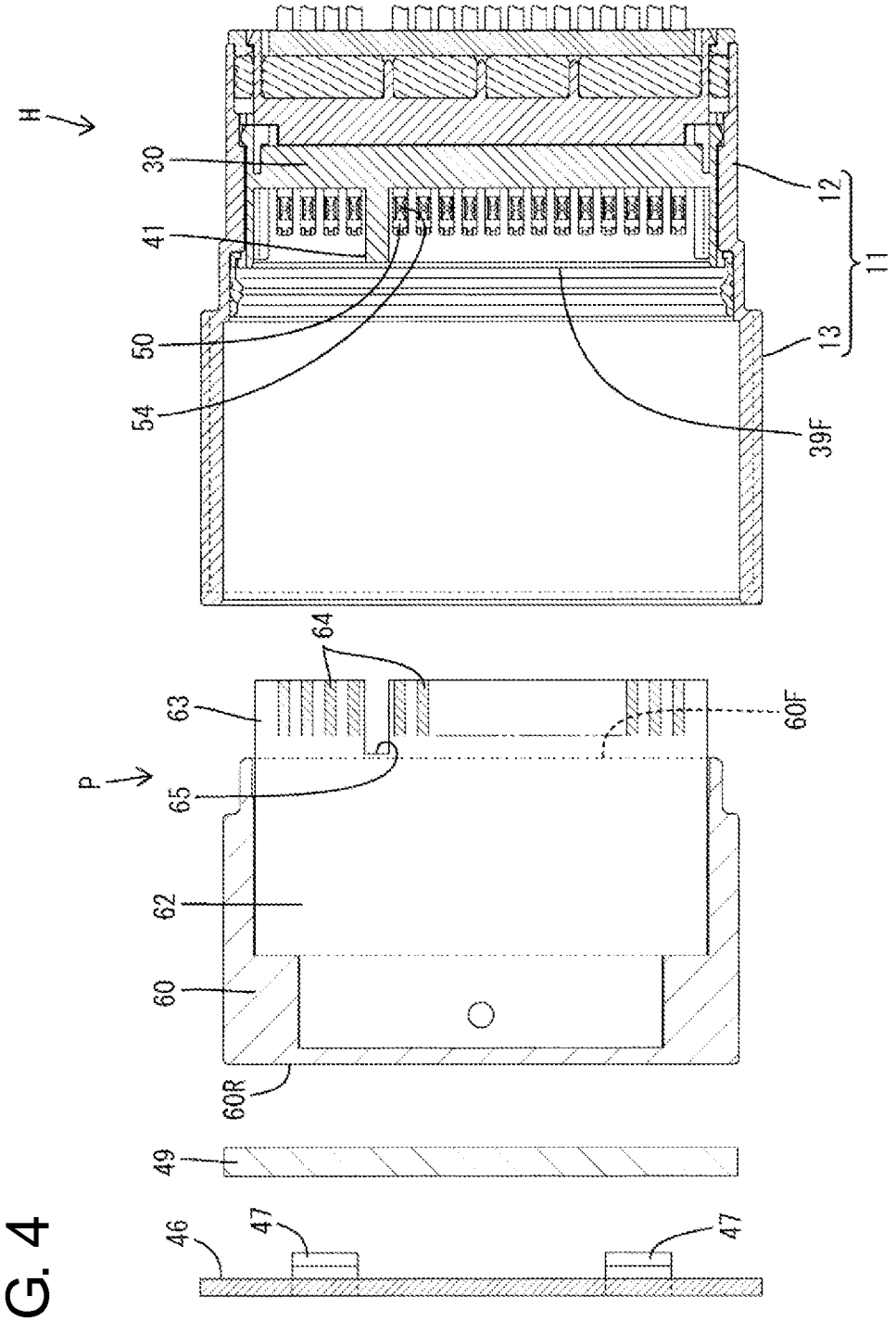

FIG. 4

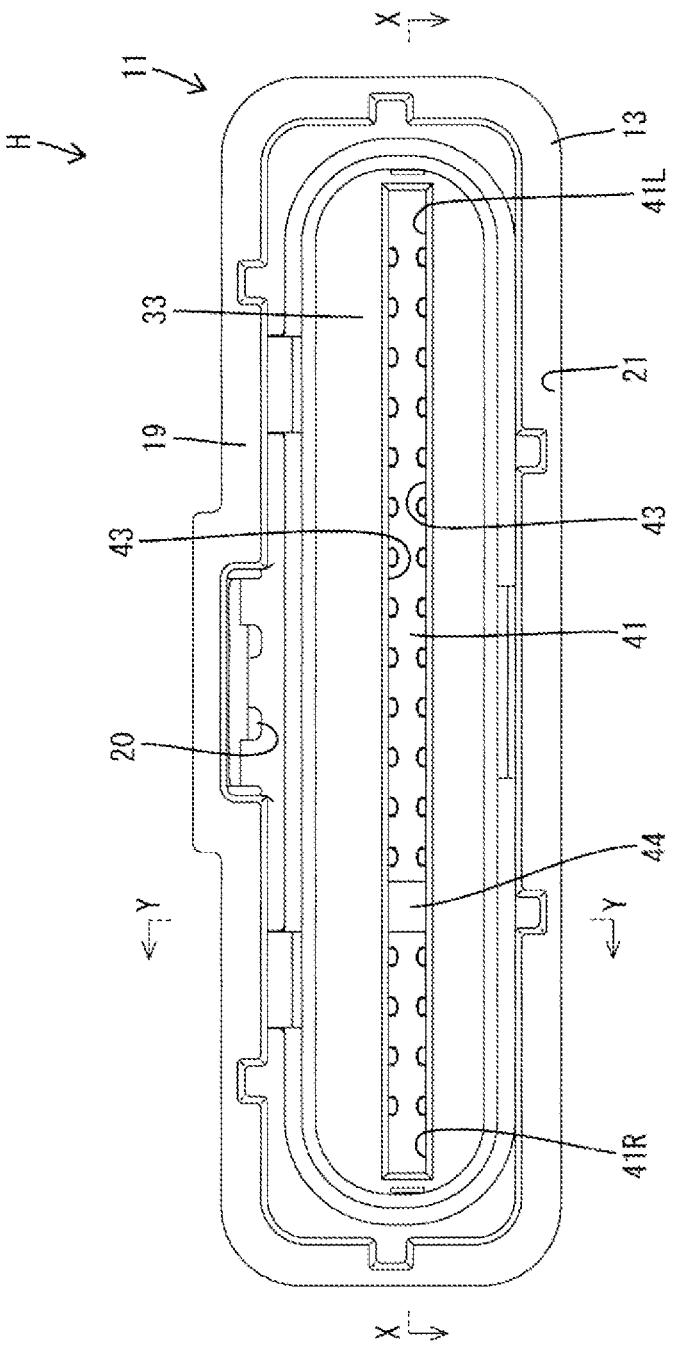

FIG. 5

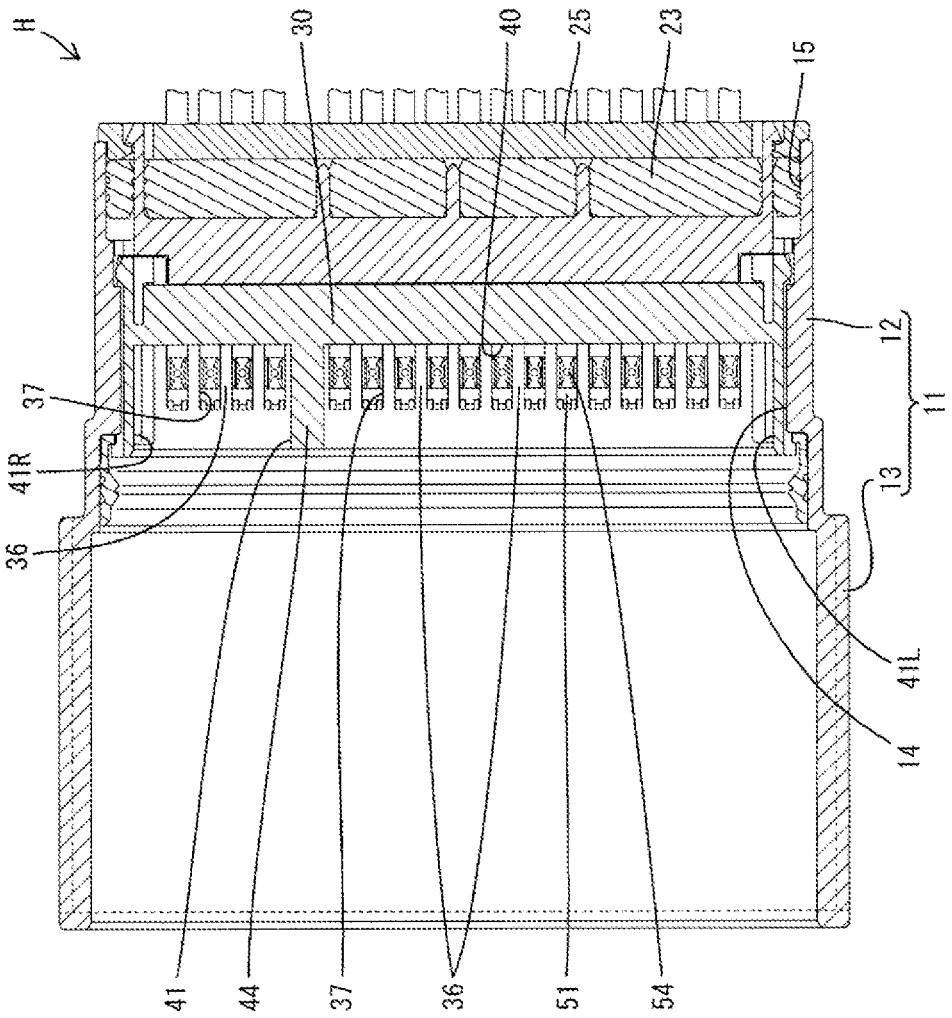

FIG. 6

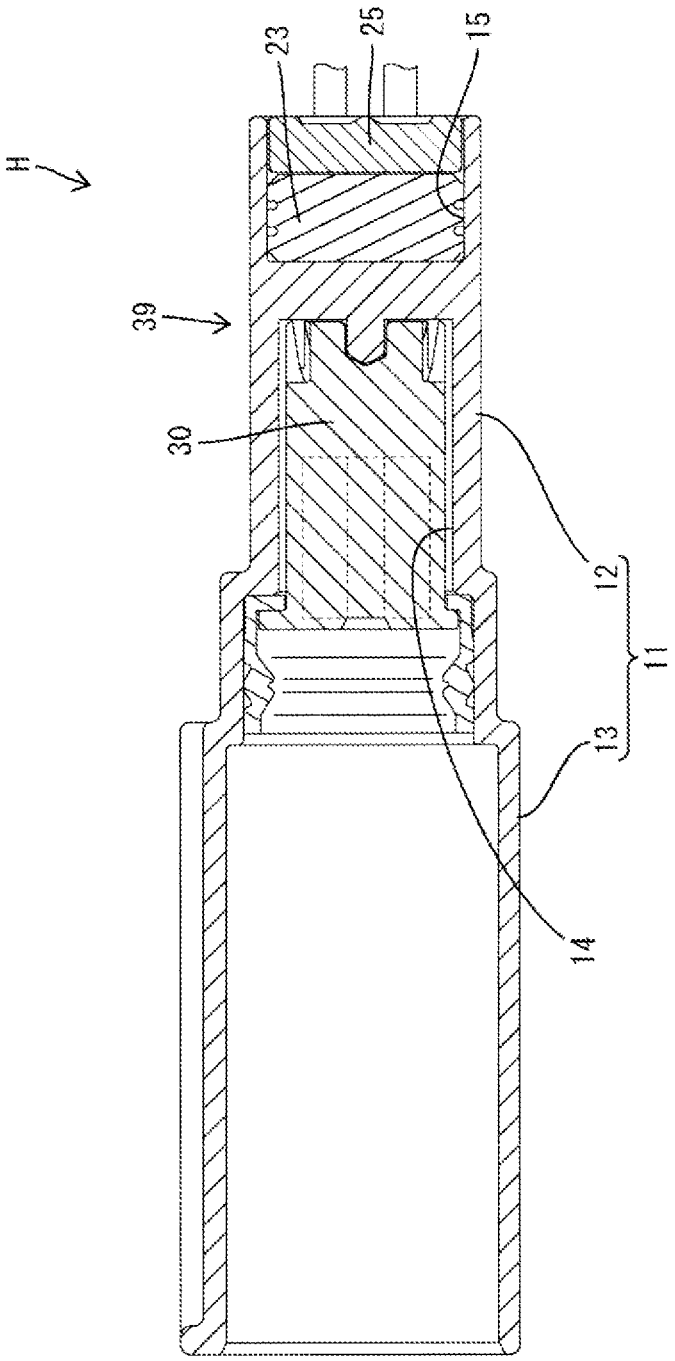

FIG. 7

CARD EDGE CONNECTOR

BACKGROUND

1. Field of the Invention

The present invention relates to a card edge connector.

2. Description of the Related Art

A card edge connector configured by connecting a housing connector in which a plurality of terminal fittings are juxtaposed in a harness-side housing and a board-side connector in which a circuit board is attached to a board-side housing is disclosed in Japanese Unexamined Patent Publication No. 2008-091047. When the two housings are connected, resilient contact pieces of the plurality of terminal fittings are resiliently brought into contact with a plurality of contact portions juxtaposed on an edge portion of a circuit board.

The harness-side housing includes a pair of supporting wall portions, a front wall portion connected to the front end edges of the supporting wall portions and a board accommodation space having a slit-like opening on the front wall portion. The plurality of terminal fittings are juxtaposed along the pair of supporting wall portions and the resilient contact pieces of the terminal fittings are facing the board accommodation space. When the circuit board is inserted into the board accommodation space, the resilient contact pieces resiliently press the circuit board and reaction forces thereof are received by the supporting wall portions, whereby a predetermined contact pressure is ensured between the terminal fittings and the circuit board.

If widths of the supporting wall portions of the above harness-side housing increase with an increase in the number of the juxtaposed terminal fittings, the rigidity of the supporting wall portions is reduced. In this case, the supporting wall portions are deformed to be curved without being able to receive the reaction forces from the circuit board side due to the resilient pressing action of the resilient contact pieces, with the result that the contact pressure between the terminal fittings and the circuit board may be reduced.

The present invention was completed in view of the above situation and aims to improve contact reliability between terminal fittings and a circuit board.

SUMMARY OF THE INVENTION

The present invention is directed to a card edge connector with a harness-side connector in which a plurality of terminal fittings are juxtaposed in a harness-side housing and a board-side connector in which a circuit board is attached to a board-side housing, resilient contact pieces of the terminal fittings being resiliently brought into contact with the circuit board when the circuit board is inserted into a board accommodation space in the harness-side housing, including a terminal holding member constituting the harness-side housing, including the board accommodation space and configured to hold the plurality of terminal fittings in juxtaposition, a housing main body constituting the harness-side housing and formed with a receptacle configured to accommodate the board-side connector, a front space formed in the housing main body and configured to accommodate the terminal holding member, a supporting wall portion formed in the terminal holding member to extend along the plurality of juxtaposed terminal fittings and configured to receive reaction forces given to the terminal fittings from the side of the circuit board due to a resilient pressing action of the resilient contact pieces, a front wall portion formed in the terminal

holding member to be connected to a front end edge of the supporting wall portion, a board insertion port formed on the front wall portion, in the form of a slit-like opening substantially parallel to a juxtaposition direction of the terminal fittings and communicating with the board accommodation space, a coupling portion formed on the front wall portion and configured to couple a pair of long-side opening edges substantially parallel to the supporting wall portion out of opening edges of the board insertion port, and a cut portion formed on the circuit board and configured to avoid interference with the coupling portion in a state inserted in the board accommodation space.

If the supporting wall portion cannot receive reaction forces resulting from the resilient pressing action of the resilient contact pieces, the front wall portion is deformed to be expanded to widen a spacing between the pair of long-side opening edges substantially parallel to the supporting wall portion out of the opening edges of the board insertion port as the supporting wall portion is curved and deformed. Focusing on this point, the present invention regulates expansion deformation of the front wall portion and prevents the supporting wall portion from being curved and deformed by coupling the pair of long-side opening edges by the coupling portion. Since the supporting wall portion can reliably receive the reaction forces due to the resilient pressing action of the resilient contact pieces in this way, a contact pressure between the terminal fittings and the circuit board is kept at a predetermined value and contact reliability is excellent.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a perspective view of a card edge connector of one embodiment.

FIG. **2** is a side view in section of the card edge connector.

FIG. **3** is a plan view in section of the card edge connector.

FIG. **4** is a plan view in section showing a state where a harness-side connector and a board-side connector are separated.

FIG. **5** is a front view of the harness-side connector.

FIG. **6** is a section along X-X of FIG. **5**.

FIG. **7** is a section along Y-Y of FIG. **5**.

DETAILED DESCRIPTION

In the card edge connector of the present invention, the front wall portion may constitute terminal accommodating chambers for accommodating the plurality of terminal fittings, and the coupling portion and the cut portion may be fitted to each other in a state held in contact in the juxtaposition direction of the terminal fittings.

According to this configuration, since the plurality of contact portions of the circuit board and the plurality of terminal fittings are positioned in the juxtaposition direction of the terminal fittings by fitting the coupling portion and the cut portion, contact reliability is excellent.

In the card edge connector of the present invention, the front wall portion may constitute terminal accommodating chambers for accommodating the plurality of terminal fittings, and the coupling portion and the cut portion may be press-fitted to each other.

According to this configuration, since relative displacements of the circuit board and the terminal fittings are regulated by press-fitting the coupling portion and the cut portion to each other, the contact pressure is stable even if the card edge connector receives vibration.

In the card edge connector of the present invention, the coupling portion and the cut portion may be arranged at a position deviated from a central position of the long-side opening edges in a length direction.

According to this configuration, the circuit board interferes with the coupling portion if it is attempted to insert the circuit board in an inverted incorrect posture into the board insertion port. This can prevent the circuit board from being inserted in an incorrect posture.

Hereinafter, one specific embodiment of the present invention is described with reference to FIGS. **1** to **7**. A card edge connector of this embodiment includes a harness-side connector H and a board-side connector P as shown in FIGS. **2** and **3**. The board-side connector P is connected to the harness-side connector H from front of the harness-side connector H. In the following description, forward and backward directions are based on the harness-side connector H. Further, a front-back direction and a connecting direction of the two connectors H, P are synonymous.

<Harness-Side Connector H>

The harness-side connector H includes a harness-side housing **10**, a plurality of terminal fittings **50** and as many wires **53** as the terminal fittings **50**. The plurality of terminal fittings **50** are accommodated in the harness-side housing **10** while being juxtaposed at predetermined intervals in a lateral direction (width direction). The wire **53** is connected to a rear end part of each terminal fitting **50**. These wires **53** are drawn out to a side backwardly of the harness-side housing **10**.

<Harness-Side Housing **10**>

The harness-side housing **10** includes a housing main body **11**, a one-piece rubber plug **23**, a rear holder **25**, a terminal holding member **30**, a seal ring **45**, a cap **46** and a resilient member **49** and is configured by assembling these components **11**, **23**, **25**, **30**, **45** and **46**.

The housing main body **11** is made of a PBT resin (polybutylene terephthalate) material to form resiliently deflectable locking lances **18** to be described later. A linear expansion coefficient of the PBT resin is approximately 100 ppm/C.°. The housing main body **11** has, as a whole, a flat outer shape in which a height (vertical dimension) is set to be smaller than a width and a dimension in the front-back direction. The housing main body **11** is configured by integrally forming a main body portion **12** and a receptacle **13** cantilevered forward from the outer peripheral edge of the front end of the main body portion **12**. As shown in FIGS. **6** and **7**, a single front space **14** is formed in the main body portion **12** by recessing a substantially entire area of the front end surface of the main body portion **12**. The terminal holding member **30** is accommodated into the front space **14**. Further, a single rear space **15** is formed in the main body portion **12** by recessing a substantially entire area of the rear end surface of the main body portion **12**.

As shown in FIG. **2**, a plurality of rear cavities **16** allowing communication between the front and rear spaces **14** and **15** of the main body portion **12** are formed between the both spaces **14**, **15**. The plurality of rear cavities **16** are juxtaposed at predetermined intervals in the width direction into each of two separate upper and lower rows. The rear cavities **16** in the upper stage and those of the lower stage are separated by a separation wall **17**. Further, the locking lances **18** cantilevered obliquely forward from the front ends of the respective rear cavities **16** and located in the front space **14** are formed in the main body portion **12**. The locking lances **18** are resiliently deflectable in a vertical direction (direction intersecting with an inserting direction of the terminal fittings **50** into the harness-side housing **10**).

An inner space of the receptacle **13** communicates with the front space **14** of the main body portion **12**. The board-side connector P is accommodated into the receptacle **13** from front of the receptacle **13**. A lock arm **20** is formed on an upper wall portion **19** constituting the receptacle **13**. The lock arm **20** is resiliently deflectable in the vertical direction (direction intersecting with the connecting direction of the two connectors H, P). Further, each of the upper wall portion **19** and a lower wall portion **21** constituting the receptacle **13** is formed with a locking recess **22** by recessing the outer surface of a front end part thereof in a stepped manner.

As shown in FIG. **2**, the one-piece rubber plug **23** and the rear holder **25** are accommodated in the rear space **15**. The one-piece rubber plug **23** is formed with a plurality of seal holes **24** separated in two upper and lower stages and penetrating in the front-back direction. The one-piece rubber plug **23** is held in close contact with the inner peripheral surface of the rear space **15** in a liquid-tight manner for sealing. The rear holder **25** is assembled into the housing main body **11** in a state arranged behind and proximate to the one-piece rubber plug **23**. The rear holder **25** regulates a backward separation of the one-piece rubber plug **23**. The rear holder **25** is formed with a plurality of through holes **26** corresponding to the respective seal holes **24**.

<Terminal Holding Member **30**>

The terminal holding member **30** is made of a glass-containing PPS resin (polyphenylene sulfide) material to have a linear expansion coefficient comparable to that of the circuit board **62**. The linear expansion coefficient of the glass-containing PPS resin is approximately 10 to 30 ppm/C.° (e.g. Torelina (registered trademark), which is PPS resin produced by Toray Industries Inc., has a linear expansion coefficient of 23 ppm/C.° in a flowing direction and a linear expansion coefficient of 31 ppm/C.° in a perpendicular direction). The linear expansion coefficient of the glass-containing PPS resin of the terminal holding member **30** is about 1/10 to 3/10 of that of the PBT resin of the housing main body **11**. The terminal holding member **30** has, as a whole, a flat outer shape in which a height (vertical dimension) is set to be smaller than a width. As shown in FIGS. **2** and **3**, the terminal holding member **30** is a single component including a pair of upper and lower supporting wall portions **31**, a pair of left and right side wall portions **32** and a front wall portion **33**. The pair of side wall portions **32** couple opposite left and right end edges of the both upper and lower supporting wall portions **31**. The front wall portion **33** couples front end edges of the both supporting wall portions **31** and is connected to the front ends of the side wall portions **32**. Any of these wall portions **31**, **32** and **33** constitutes an outer wall surface of the terminal holding member **30**.

The terminal holding member **30** is accommodated in the front space **14**. As shown in FIG. **3**, resilient locking pieces **34** formed on the outer surfaces of the both left and right side wall portions **32** of the terminal holding member **30** are locked to locking steps **27** formed on the opposite left and right inner surfaces of the front space **14**. By this locking action of the resilient locking pieces **34** and the locking steps **27**, the terminal holding member **30** is held in the front space **14**. As shown in FIGS. **2** and **3**, a flange portion **35** is formed on the outer periphery of a front end part of the terminal holding member **30**. A rear end part of the seal ring **45** made of rubber is locked to this flange portion **35**. By this locking action, the seal ring **45** is assembled into the housing main body **11** in a state where the outer periphery thereof is held in close contact with the inner periphery of a rear end part

of the receptacle **13** and the seal ring **45** is arranged before the terminal holding member **30**.

As shown in FIG. **6**, a plurality of rib-like partition walls **36** projecting from the inner surfaces of the both supporting wall portions **31** toward a vertical center are formed in the terminal holding member **30**. The partition walls **36** are long and narrow in the front-back direction and juxtaposed in the lateral direction. A space defined by the supporting wall portion **31** and the partition walls **36** serves as a front cavity **37**. Thus, a plurality of (as many as the rear cavities **16**) front cavities **37** separated in two upper and lower stages are juxtaposed at predetermined intervals (same intervals as the rear cavities **16**) in the width direction. The inner surfaces of the supporting wall portions **31** and the side surfaces of the partition walls **36** are directly facing the front cavities **37**. The plurality of front cavities **37** and the plurality of rear cavities **16** are respectively arranged one after the other in one-to-one correspondence to constitute terminal accommodating chambers **38**. The main body portion **12** of the housing main body **11** and the terminal holding member **30** constitute a terminal accommodating portion **39** for accommodating the plurality of terminal fittings **50** in juxtaposition.

As shown in FIG. **2**, out of an inner space of the terminal holding member **30**, a space between the front cavities **37** in the upper stage and those in the lower stage serves as a single board accommodation space **40** set to have a smaller vertical dimension than a lateral dimension. The front cavities **37** in the upper stage and those in the lower stage are directly facing the board accommodation space **40**. The front wall portion **33** is formed with a slit-like board insertion port **41** long and narrow in the lateral direction and penetrating in the front-back direction. The front end of the board accommodation space **40** communicates with the board insertion port **41**.

Further, the front wall portion **33** is formed with a pair of upper and lower receiving plate portions **42** for supporting front end parts of box portions **51** of the terminal fittings **50** accommodated in the front cavities **37**. The receiving plate portions **42** are cantilevered backward from a pair of upper and lower long-side opening edges **43** along the lateral direction (length direction of the board insertion port **41**) out of opening edges of the board insertion port **41**. In a state where the box portions **51** of the terminal fittings **50** are accommodated in the front cavities **37**, displacements of the front end parts of the box portions **51** toward the board accommodation space **40** are regulated by the receiving plate portions **42**. In this way, the terminal fittings **50** are so held as not be vertically inclined.

Since the front ends of the supporting wall portions **31** are connected to the front wall portion **33**, the front wall portion **33** is deformed to be vertically expanded if the supporting wall portion **31** is deformed to bulge toward an outer surface side of the terminal holding member **30** (upwardly or downwardly). Associated with this deformation of the front wall portion **33**, the upper and lower long-side opening edges **43** of the board insertion port **41** are relatively displaced away from each other. In this embodiment, the front wall portion **33** is formed with one coupling portion **44** for coupling the long-side opening edges **43** as shown in FIGS. **3**, **5** and **6** as a means for preventing the board insertion port **41** from being deformed to be vertically widened.

The front end edge of the coupling portion **44** is connected to the front wall portion. The upper end edge of the coupling portion **44** is connected to the upper supporting wall portion **31**. The lower end edge of the coupling portion **44** is connected to the lower supporting wall portion **31**. The rear end edge of the coupling portion **44** is connected to the front end of the separation wall **17**. That is, the coupling portion **44** is connected in an entire area from the front ends to the rear ends of the pair of upper and lower supporting wall portions **31**. Thus, the deformation of the upper and lower supporting wall portions **31** away from each other is regulated by this coupling portion **44**.

Further, by being formed with the coupling portion **44**, the board insertion port **41** is divided into two left and right opening areas **41**L, **41**R as shown in FIGS. **5** and **6**. Accordingly, two (a plurality of) opening areas **41**L, **41**R correspond to the board accommodation space **40** as a single space. The coupling portion **44** is arranged at a position deviated in the lateral direction from a central position of the long-side opening edges **43** in the length direction. That is, the coupling portion **44** is asymmetrically arranged in the lateral direction. The shapes and sizes of the two opening areas **41**L, **41**R are asymmetrical in the lateral direction.

As shown in FIG. **2**, the cap **46** made of synthetic resin is mounted on the receptacle **13** to close an opening on the front end of the receptacle **13** from front. A board-side housing **60** is entirely accommodated in the receptacle **13** in a state where the both connectors H, P are properly connected. Thus, the cap **46** is in the form of a flat plate as a whole. A locking arm **47** is formed on each of upper and lower end edges of the cap **46**. The cap **46** mounted on the receptacle **13** is held so as not be separated forwardly from the receptacle **13** by locking the locking arms **47** to the locking recesses **22** of the receptacle **13**. This cap **46** and the receptacle **13** constitute a housing accommodating portion **48** for accommodating the board-side housing **60**.

The housing accommodating portion **48** is arranged before and adjacent to the terminal accommodating portion **39**. Further, an inner space of the housing accommodating portion **48** communicates with the board accommodation space **40** via the board insertion port **41**. The resilient member **49** made of a rubber material is accommodated in the housing accommodating portion **48**. The resilient member **49** is arranged to be held in close contact with a substantially entire area of the inner surface (rear surface) of the cap **46**. The rear surface of the resilient member **49** is held in close contact with a substantially entire area of a rear surface **60**R of the board-side housing **60**. When the cap **46** is mounted on the receptacle **13**, the resilient member **49** is sandwiched between the cap **46** and the board-side housing **60** to be resiliently squeezed.

<Terminal Fitting **50**>

The terminal fitting **50** is formed into a long and narrow shape in the front-back direction (direction perpendicular to a juxtaposition direction of the terminal fittings **50**) as a whole. The terminal fitting **50** is formed by bending and assembling two metal plate members punched out into predetermined shapes. As shown in FIG. **2**, a front end side area of the terminal fitting **50** serves as the box portion **51** of a known form. A rear end side area of the terminal fitting **50** serves as a crimping portion **52** of a known form, and a front end part of the wire **53** constituting a wiring harness is connected to the crimping portion **52** by crimping. The box portion **51** includes a resilient contact piece **54**. A part of the resilient contact piece **54** projects out from the box portion **51**.

The terminal fitting **50** is inserted into the terminal accommodating chamber **38** by successively passing through the through hole **26** of the rear holder **25** and the seal hole **24** of the one-piece rubber plug **23**. The inserted terminal fitting **50** has the rear end of the box portion **51**

locked by the locking lance **18**, thereby being retained and held. With the terminal fitting **50** inserted, the box portion **51** and the resilient contact piece **54** are arranged in the front cavity **37** and the crimping portion **52** is arranged in the rear cavity **16**. That is, the box portion **51** (front end side part of the terminal fitting **50**) is held over the entire length from the front end to the rear end thereof by the terminal holding member **30**. Further, the crimping portion **52** (rear end side part of the terminal fitting **50**) is arranged over the entire length thereof in the housing main body **11**.

With the terminal fitting **50** inserted in each terminal accommodating chamber **38**, a part of the resilient contact piece **54** projects toward a side opposite to the supporting wall portion **31** and is located in the board accommodation space **40**. Further, each terminal fitting **50** is sandwiched from left and right sides by the partition walls **36**, thereby being positioned with respect to the terminal holding member **30** so as not to largely rattle in the lateral direction (juxtaposition direction).

<Board-Side Connector P>

As shown in FIGS. **2** to **4**, the board-side connector P is an integral assembly of the board-side housing **60** made of synthetic resin and the circuit board **62** by molding. The board-side housing **60** has a flat shape as a whole in which a height (vertical dimension) is set to be smaller than a width. As shown in FIG. **2**, a lock projection **61** is formed on the upper surface (outer surface) of the board-side housing **60**. Circuits are formed by printing and electronic components and the like (not shown) are mounted on opposite upper and lower surfaces (both sides) of the circuit board **62**. An end edge part of the circuit board **62** on the side of the harness-side connector H serves as a connecting edge portion **63** as a connection means to the terminal fittings **50**.

The circuit board **62** is made of a glass epoxy resin material. A linear expansion coefficient of the glass epoxy resin material is approximately 10 to 15 ppm/° C. substantially equal to that of the glass-containing PPS resin as the material of the terminal holding member **30**. An entire area of the circuit board **62** except the connecting edge portion **63** is embedded in the board-side housing **60**. Accordingly, the connecting edge portion **63** of the circuit board **62** projects from a front surface **60**F of the board-side housing **60** toward the harness-side housing **10**. As shown in FIGS. **3** and **4**, a plurality of contact portions **64** constituting the circuits are juxtaposed at the same interval as the terminal fittings **50** on opposite upper and lower surfaces of this connecting edge portion **63**. Further, the connecting edge portion **63** is formed with a cut portion **65** corresponding to the coupling portion **44** of the harness-side housing **10**.

<Functions and Effects>

In connecting the harness-side connector H and the board-side connector P, the board-side connector P is inserted into the receptacle **13** with the cap **46** removed from the receptacle **13**. In an inserting process, the connecting edge portion **63** of the circuit board **62** is inserted into the board accommodation space **40** through the board insertion port **41**. At this time, the cut portion **65** and the coupling portion **44** are press-fitted and engaged. When the two connectors H, P are properly connected, they are locked in a connected state by the locking action of the lock arm **20** and the lock projection **61**. Further, the resilient contact pieces **54** of the terminal fittings **50** in the upper and lower stages respectively resiliently come into contact with the contact portions **64** on the upper and lower surfaces of the connecting edge portion **63** and the circuit board **62** and the terminal fittings **50** are electrically conductively connected. Further, a clearance between the inner surface of the receptacle **13** and the outer surface of the board-side housing **60** is sealed by the seal ring **45**.

After the board-side connector P is inserted into the receptacle **13**, the resilient member **49** is held in close contact with the rear surface **60**R of the board-side housing **60** and the cap **46** is brought into contact with the front surface of the resilient member **49** and mounted on the receptacle **13**. Then, the resilient member **49** is resiliently deformed to be squeezed in the front-back direction, and the front surface **60**F of the board-side housing **60** is resiliently pressed against a front surface **39**F of the terminal accommodating portion **39** (terminal holding member **30**) by a resilient restoring force of this resilient member **49**. By this resilient pressing action, relative displacements of the two housings **10**, **60** in the front-back direction are regulated. Further, relative displacements of the two housings **10**, **60** in directions (vertical direction and lateral direction) intersecting with the connecting direction due to a frictional force resulting from resilient pressing are also regulated. In the above way, the connection of the two connectors H, P is completed.

In the card edge connector of this embodiment, the harness-side housing **10** is provided with the terminal accommodating portion **39** for accommodating the plurality of terminal fittings **50** and the housing accommodating portion **48** arranged to face the front surface **39**F of the terminal accommodating portion **39** and configured to accommodate the board-side housing **60**. The resilient member **49** for biasing the terminal accommodating portion **39** and the board-side housing **60** in a direction toward each other in parallel to the connecting direction is provided in the housing accommodating portion **48**.

According to this configuration, relative displacements of the board-side housing **60** and the terminal accommodating portion **39** are regulated by a biasing force of the resilient member **49**, wherefore position shifts between the terminal fittings **50** and the circuit board **62** caused by vibration resulting from relative displacements of the two housings **10**, **60** are prevented. Thus, the card edge connector of this embodiment is excellent in the contact reliability of the terminal fittings **50** and the circuit board **62**.

Further, the housing accommodating portion **48** includes the receptacle **13** integrated with the terminal accommodating portion **39** and projecting forwardly of the terminal accommodating portion **39** and the cap **46** to be mounted on the receptacle **13** to close the opening on the front end of the receptacle **13**. According to this configuration, when the two housings **10**, **60** are connected, the board-side housing **60** is accommodated into the receptacle **13**. Thus, the two housings **10**, **60** can be positioned so as not to be displaced relative to each other until the cap **46** is mounted.

Further, the entire board-side housing **60** is accommodated in the receptacle **13** with the two connectors H, P properly connected. Thus, the board-side housing **60** can be protected from the interference of external matters until the resilient member **49** and the cap **46** are mounted after the two connectors H, P are connected.

Further, the resilient member **49** is arranged between the rear surface **60**R of the board-side housing **60** in the receptacle **13** and the inner surface of the cap **46**. According to this configuration, the board-side housing **60** is pressed against the terminal accommodating portion **39** by being biased from the side of the rear surface **60**R by the resilient member **49**, and relative displacements of the harness-side housing **10** and the board-side housing **60** are regulated by this pressing action. Thus, in the card edge connector of this

embodiment, a projecting distance of the circuit board **62** from the board-side housing **60** can be made shorter as compared with the case where the resilient member **49** is interposed between the front surface **39**F of the terminal accommodating portion **39** and the front surface **60**F of the board-side housing **60**.

Further, the resilient member **49** is produced as a component separate from the housing accommodating portion **48**. This resilient member **49** is accommodated in the housing accommodating portion **48**. If an attempt is made to integrally form a component constituting the housing accommodating portion **48** and the resilient member **49**, there are restrictions such as the possibility of mold removal, resilient strength and the like. Thus, a degree of freedom in design is low. Contrary to this, in this embodiment, the resilient member **49** is a component separate from the housing accommodating portion **48**. Thus, a degree of freedom is high in designing the housing accommodating portion **48** and the resilient member **49**.

Further, since the board-side housing **60** is integrally formed to the circuit board **62** by molding, there is no relative displacement between the board-side housing **60** and the circuit board **62**. Since relative displacements of the board-side housing **60** and the harness-side housing **10** are regulated by the resilient member **49**, relative displacements of the terminal fittings **50** to the circuit board **62** are reliably regulated.

Further, since the resilient contact pieces **54** of the terminal fittings **50** are resiliently in contact with the circuit board **62** in a state where the terminal fittings **50** and the circuit board **62** are connected, reaction forces resulting from resilient restoring forces of the resilient contact pieces **54** are given toward the terminal fittings **50** from the side of the circuit board **62**. These reaction forces are received by the supporting wall portions **31** located at sides of the terminal fittings **50** opposite to the circuit board **62**. However, since the supporting wall portions **31** are provided along the plurality of juxtaposed terminal fittings **50**, the rigidity of the supporting wall portions **31** is reduced if a large number of terminal fittings **50** are juxtaposed and the supporting wall portions **31** have a large width. In this case, the supporting wall portions **31** may be curved and deformed to bulge out in directions away from the circuit board **62** (upwardly or downwardly) without being able to receive the reaction forces from the side of the circuit board **62**. If such deformation occurs, a contact pressure between the terminal fittings **50** and the circuit board **62** may be reduced.

Accordingly, in this embodiment, the pair of long-side opening edges **43** substantially parallel to the supporting wall portions **31** out of the opening edges of the board insertion port **41** are coupled by the coupling portion **44**, focusing on the board insertion port **41** of the front wall portion **33** connected to the front end edges of the supporting wall portions **31**. Since vertical widening of the board insertion port **41** can be regulated in this way, the deformation of the upper and lower edge parts of the front wall portion **33** to bulge outwardly is also regulated and, consequently, the upper and lower supporting wall portions **31** are prevented from being curved and deformed. Since the supporting wall portions **31** can reliably receive reaction forces resulting from the resilient pressing action of the resilient contact pieces **54** in this way, the contact pressure between the terminal fittings **50** and the circuit board **62** can be kept at a predetermined value.

Further, since the connecting edge portion **63** of the circuit board **62** is inserted into the board insertion port **41**, the circuit board **62** may interfere with the coupling portion **44** to obstruct the connection of the two connectors H, P. However, since the connecting edge portion **63** of the circuit board **62** is formed with the cut portion **65** for avoiding interference with the coupling portion **44** in the inserting process into the board insertion port **40**, the connection of the two connectors H, P is not obstructed.

Further, the front wall portion **33** constitutes the terminal accommodating chambers **38** for accommodating the plurality of terminal fittings **50**. The coupling portion **44** and the cut portion **65** are engaged while being held in contact in the juxtaposition direction of the terminal fittings **50**. According to this configuration, by the engagement of the coupling portion **44** and the cut portion **65**, the plurality of contact portions **64** of the circuit board **62** and the resilient contact pieces **54** of the plurality of terminal fittings **50** are positioned in the juxtaposition direction of the terminal fittings **50**. Thus, contact reliability is excellent. In addition, since the coupling portion **44** and the cut portion **65** is press-fitted and engaged, relative displacements of the circuit board **62** and the terminal fittings **50** are regulated not only in the lateral direction, but also in the front-back direction and the vertical direction. Therefore, even if the card edge connector receives vibration, the contact pressure between the terminal fittings **50** and the circuit board **62** is stable.

Further, the coupling portion **44** and the cut portion **65** are arranged at the position deviated from the central position of the long-side opening edges **43** in the length direction. According to this configuration, if an attempt is made to insert the circuit board **62** in a laterally inverted incorrect posture into the board insertion port **41**, the circuit board **62** interferes with the coupling portion **44**, wherefore the insertion of the circuit board **62** in an incorrect posture can be prevented.

Further, the harness-side housing **10** includes the terminal accommodating portion **39** for accommodating the plurality of terminal fittings **50** in the state positioned in the juxtaposition direction. At least a part (terminal holding member **30**) of the terminal accommodating portion **39** is made of the material (PPS resin) having a linear expansion coefficient substantially equal to that of the material (glass epoxy resin) of the circuit board **62**. According to this configuration, when the card edge connector becomes hot, the juxtaposition interval of the terminal fittings **50** and that of the contact portions **64** of the circuit board **62** are unlikely to deviate from each other. Thus, the card edge connector of this embodiment is excellent in contact reliability.

Further, the terminal accommodating portion **39** includes the housing main body **11** and the terminal holding member **30**. The housing main body **11** is formed with the locking lances **18** resiliently deflectable to retain the terminal fittings **50**. The terminal holding member **30** is separate from the housing main body **11** and made of the material having a linear expansion coefficient approximately equal to that of the circuit board **62**. According to this configuration, the terminal fittings **50** can be reliably retained by the resiliently deflectable locking lances **18** while suppressing a deviation between the juxtaposition interval of the contact portions **64** of the circuit board **62** and that of the terminal fittings **50** during thermal expansion and contraction.

Further, the terminal fitting **50** includes the resilient contact piece **54** to be resiliently brought into contact with the contact portion **64** of the circuit board **62**. The terminal holding member **30** holds at least a part of the terminal fitting **50** corresponding to the resilient contact piece **54** in the state positioned in the juxtaposition direction. According to this configuration, a deviation between the juxtaposition interval of the resilient contact pieces **54** and that of the

contact portions **64** during thermal expansion and contraction can be effectively suppressed.

Further, the terminal holding member **30** constituting the front end of the terminal accommodating portion **39** and the main body portion **12** constituting the rear end side of the terminal accommodating portion **39** have different linear expansion coefficients. Thus, in the process of thermal expansion and contraction, a displacement amount in the lateral direction differs between the front end side and the rear end side of the terminal fitting **50**. As a result, the terminal fitting **50** may be inclined in the lateral direction. However, in this embodiment, the front end side part of the terminal fitting **50** serves as the box portion **51** for holding the resilient contact piece **54** and this box portion **51** is held over the entire length thereof in the state positioned in the juxtaposition direction by the terminal holding member **30**. Thus, the orientation of the terminal fitting **50** is kept constant by the terminal holding member **30** in the process of thermal expansion and contraction.

Further, the board-side housing **60** is accommodated over the entire length thereof in the receptacle **13** in the state where the harness-side connector H and the board-side connector P are properly connected. That is, the entire board-side housing **60** is accommodated in the receptacle **13**. This structure enables position shifts between the housings **10** and **60** due to vibration to be suppressed also in a state where the cap **46** and the resilient member **49** are not assembled yet as compared with the case where a projecting distance of the receptacle **13** is short and only a part of the board-side housing **60** is accommodated in the receptacle **13**.

Further, the card edge connector of this embodiment can be used without assembling the cap **46** and the resilient member **49** in the state where the harness-side connector H and the board-side connector P are connected. In this case, position shifts between the housings **10** and **60** due to vibration can be more effectively suppressed or more reliably prevented if the two housings **10**, **60** are fixed so as not to move relative to each other such as by mounting a fixing member made of rubber (not shown) on the harness-side housing **10** and the board-side housing **60**. As a means for reliably preventing position shifts between the housings **10** and **60** without assembling the cap **46** and the resilient member **49**, the two housings **10**, **60** may be fixed to a body of a vehicle (not shown) by common bolts (not shown). As just described, the card edge connector of this embodiment can suppress or prevent position shifts between the two housings **10** and **60** due to vibration by being combined with another means instead of the cap **46** and the resilient member **49**.

The present invention is not limited to the above described and illustrated embodiment. For example, the following embodiments are also included in the technical scope of the present invention.

Although the coupling portion and the cut portion are in contact in the juxtaposition direction of the terminal fittings in the above embodiment, they may not be in contact.

Although the coupling portion and the cut portion are press-fitted to each other in the above embodiment, dimensions thereof may be set to enable them to be fitted and separated without creating large frictional resistance.

Although the coupling portion is arranged at the position deviated from the central position of the long-side opening edges in the length direction and the two opening areas divided by the coupling portion are laterally asymmetrical in the above embodiment, the coupling portion may be arranged at the central position of the long-side opening edges in the length direction and the two opening areas divided by the coupling portion may be bilaterally symmetrical.

Although only one coupling portion is provided in one board insertion port in the above embodiment, a plurality of coupling portions may be provided in one board insertion port. In this case, the plurality of coupling portions may be symmetrically arranged in the length direction of the long-side opening edges or asymmetrically arranged in the length direction of the long-side opening edges.

Although the terminal fittings are in contact with both sides of the circuit board in the above embodiment, the present invention can also be applied to a card edge connector in which terminal fittings are in contact only with one of both sides of a circuit board.

LIST OF REFERENCE SIGNS

H . . . harness-side connector
P . . . board-side connector
10 . . . harness-side housing
31 . . . supporting wall portion
33 . . . front wall portion
38 . . . terminal accommodating chamber
40 . . . board accommodation space
41 . . . board insertion port
43 . . . long-side opening edge
44 . . . coupling portion
50 . . . terminal fitting
54 . . . resilient contact piece
60 . . . board-side housing
62 . . . circuit board
65 . . . cut portion

The invention claimed is:

1. A card edge connector assembly comprising:

a board-side connector that has a board-side housing and a circuit board attached to the board-side housing, the circuit board having a front edge region projecting from the board-side housing and having a plurality of contact portions and a cut portion in proximity to the front edge region; and

a harness-side connector comprising:

a housing main body formed with a receptacle configured to accommodate the board-side connector; and

a terminal holding member inserted in the receptacle of the housing main body, the terminal holding member including:

a front wall;

opposed supporting walls extending rearward from the front wall;

a board accommodation space open into the front wall at a position between the supporting walls and configured to receive the front edge region of the circuit board;

terminal accommodating chambers formed between the support walls and adjacent the board accommodation space, the terminal accommodating chambers being configured for accommodating a plurality of juxtaposed terminal fittings and configured so that the supporting walls receive reaction forces given to the terminal fittings from the circuit board due to a resilient pressing action of resilient contact pieces of the terminal fittings; and

a coupling portion formed at the front wall portion and extending between the supporting walls; wherein

the coupling portion is disposed to fit in the cut portion formed on the circuit board and is configured to resist

the reaction forces given to the supporting walls by the terminal fittings when the circuit board is inserted in the board accommodation space.

2. The card edge connector assembly of claim **1**, wherein the coupling portion and the cut portion are press-fitted to each other.

3. The card edge connector assembly of claim **2**, wherein the coupling portion and the cut portion are arranged at a position deviated from a central position of the supporting walls in a direction transverse to a connecting direction.

4. The card edge connector assembly of claim **1**, wherein the coupling portion and the cut portion are arranged at a position deviated from a central position of the supporting walls in a direction transverse to a connecting direction.

5. The card edge connector assembly of claim **1**, wherein the circuit board has a specified linear expansion coefficient and wherein the terminal holding member is formed from a synthetic resin having a linear expansion coefficient that is substantially the same as the linear expansion coefficient of the circuit board.

6. The card edge connector assembly of claim **1**, wherein the housing main body is formed from a first resin having a first linear expansion coefficient and wherein the terminal holding member is formed from a second resin different from the first resin and has a second linear expansion coefficient that is different from the first linear expansion coefficient.

7. The card edge connector assembly of claim **6**, wherein the first resin is polybutylene terephthalate.

8. The card edge connector assembly of claim **7**, wherein the second resin is a glass-containing polyphenylene sulfide.

9. The card edge connector of claim **6**, wherein the second linear expansion coefficient is about 0.1 to 0.3 times the first linear expansion coefficient.

10. The card edge connector assembly of claim **6**, wherein the circuit board is made of a glass epoxy resin.

11. The card edge connector assembly of claim **1**, wherein the housing main body of the harness-side connector has opposite first and second ends, the terminal holding member being mounted in proximity to the first end of the housing main body, the second end of the housing main body being open and being configured for receiving the board-side connector therein, the card edge connector assembly further comprising a resilient member inserted in the opening at the second end of the housing main body and a cap mounted to the open end of the housing main body and urging the resilient member resiliently against the board-side housing so that the contact portions of the circuit board are urged into connection with the terminal fittings.

12. The card edge connector assembly of claim **10**, wherein the cap is locked to the housing main body at locations in proximity to the opening in the receptacle.

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